DR. I. M. LEVITT'S

WONDERS OF THE UNIVERSE

Hazards on the Moon

BY DR. I. M. LEVITT
Director Fel Planetarium, Philadelphia

IT WILL be like living in a vacuum tube on the moon.

Dr. I. M. Levitt

The problems that exist in an environment without atmosphere will be almost as great as putting men on the moon in the first place. But we can put a man on the moon within 10 years.

And formidable as the difficulties are, man will be able to live there — with a great deal of study and preparation and extreme ingenuity.

Man on the moon will have no natural air to breathe; he will be subject to cosmic and solar radiations of high intensities; meteors will present an everpresent danger, and radically-changing temperature will offer hazards both to the man and his equipment.

Engineers of the Aero-Jet-General corporation are studying requirements of support equipment necessary to keep man alive on the alien lunarlandscape. Their list of hazards is lengthy.

IN THE EARLY stages of manned lunar exploration, the astronaut's very life will depend on the ability of his space craft to return him to earth at a scheduled time. Delay, or any unreliability, could be fatal. And while he is there, his support material, food, atmosphere, shielding, space suit, etc., must insure his survival.

Most of this material will be quite complex. The lunar explorer must furnish his own power and have with him instruments to monitor his surroundings, his equipment and his spaceship.

The power requirements alone are considerable; conditioning for food, water and other supplies, atmospheric control, communications and possibly even propulsion will draw from his limited supplies. Facilities for the return takeoff will also require power.

COMPONENTS that can fail will include almost everything the spaceman has, requiring monitoring equipment of extreme complexity. The lack of atmosphere will allow leakage of fluids thru seals. Electronic equipment will arc if high voltages are involved. There will be no sound. Breathing and bodily functions could be impaired.

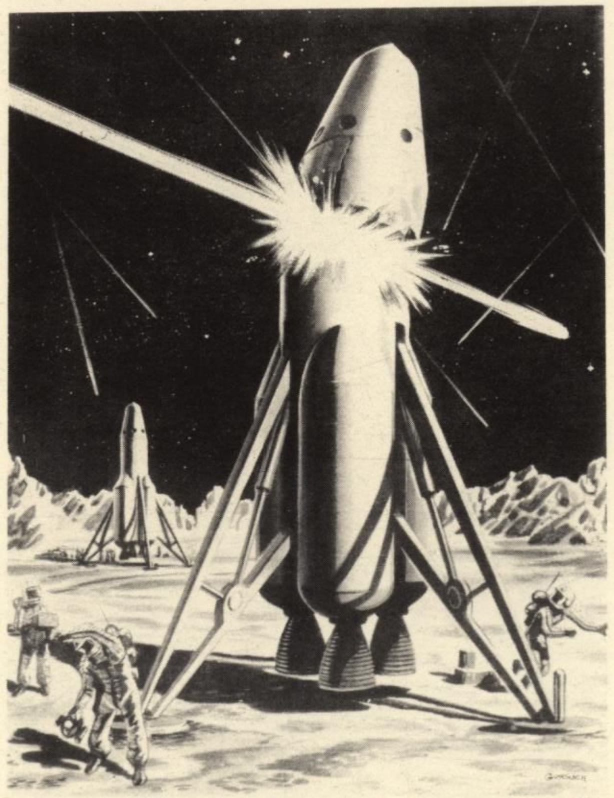
Interference may affect communications and navigational equipment. Effects on plastics and paints may be undesirable. High intensity space particles can destroy human cells or even structures.

Large meteorites may smash craft, small ones may change the surface characteristics of structural materials thru a sandblasting effect.

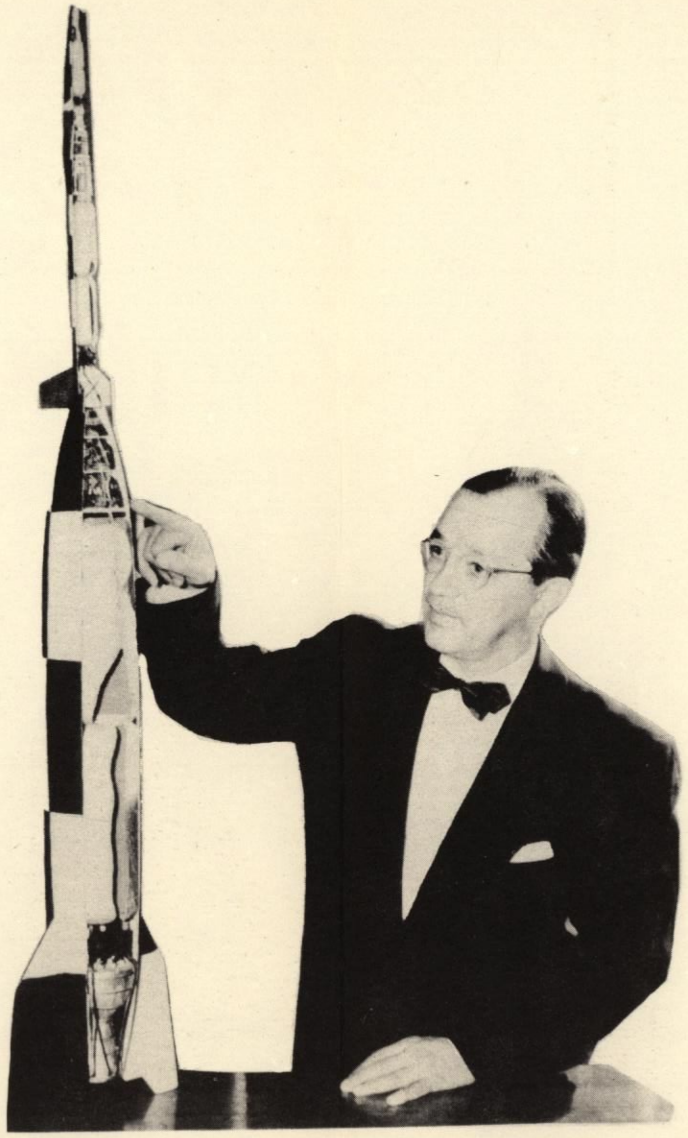
The wide range of temperatures will affect normal operations of electronic equipment as well as misalignment and possible structural failure. Temperatures may cause brittleness in some items or result in the evaporation of hydraulic fluids.

THIS IS BUT a partial list of what can go wrong when man leaves the friendly earth for the hostile moon. As investigating scientists are pointing out, situations on the two bodies are so dissimilar that a new set of values must be developed to understand and cope with the problems involved. Massive expenditures necessary for lunar exploration will place a tremendous premium on miniaturization of equipment and use of materials already on the moon.

The first explorers must carry all of their food, water and atmosphere. Their choice of a landing site will be a compromise: temperature extremes will be more moderate in areas with a low sun, but a high sun will provide more energy.



METEORITES will be but one of the many hazards man will encounter on the moon.



WONDERS OF THE UNIVERSE
By
Dr. I. M. Levitt

Director of the Fels Planetarium in Philadelphia

For more than ten years, Dr. Levitt has been pioneering in satellite, rocket and space research. His weekly column, illustrated with art, supplies a background of facts that go far beyond your regular news releases. It is the most timely material written today.

2 Paths to the Moon

BY DR. I. M. LEVITT
Director, Fel Planetarium, Philadelphia

THERE ARE TWO paths to the moon, and we must decide which to use soon. The first two steps already have been taken by the Russians. Lunik I impacted the moon, and Lunik III photographed the hidden side.

DR. I. M. LEVITT

The next move will be the establishment of a lunar satellite, and this is well on its way.

After successfully orbiting the moon with various types of satellites we will have reached the crossroads. It will be time to firm our efforts for the big job: putting a man on the moon.

We can send a space station into orbit around the earth and use its facilities to assemble a rocket there which could carry men on to the moon. This, fantastic as it may sound, is probably the most practical approach, and we will discuss it next week.

THE SECOND path would be to make a direct flight from earth, using the mightiest rocket ever to reach the planning stage.

During the recent International Astronautical federation meeting in London, Milton W. Rosen, chief of rocket vehicle development, National Aeronautics and Space administration, described a rocket that could carry two or three men to the moon and return them to earth.

The first stage of the five-stage system would use six rocket engines with a thrust of one and one-half million pounds each for a combined thrust of nine million pounds. A single engine of one and one-half million pounds of thrust would comprise the second stage. Both would use liquid oxygen and kerosene for fuel.

Four engines giving a total thrust of 600,000 pounds would make up the third stage. The propellants would be liquid oxygen and liquid hydrogen.

THE FOURTH or landing stage would also use these high-energy propellants for its four engines—and would have throttles. It would be necessary to control this stage for the set-down on the moon. Retractible, three-point landing gear with more than a 100-foot spread would also be provided.

The fifth-stage engine [contained in the fuel tank portion of the fourth stage] would provide the propellant power for the return journey.

At the beginning of its voyage, the first moon ship to fly directly from the earth would rise vertically for ten seconds before tilting to the east. The first stage would cut off at 135 seconds and 35 miles in the air. The second stage would then fire for 177 seconds, with the third stage taking over at 150 miles up and accelerating the vehicle to 36,000 feet a second before it cuts out.

BECAUSE of the moon's lesser gravity, only one stage is necessary to pull the capsule free for the trip back to earth. This is the fifth stage which would fire for 220 seconds before dropping off and reducing the vehicle to little more than the crew capsule.

Divided into two compartments, the capsule, 14 feet high and 12 in diameter, would be protected by a nose cone designed to erode away during reëntry, absorbing the frightful heat created by contact with the atmosphere.

The capsule's final approach would be conventional. A large parachute would open at 30,000 feet for an ocean landing.

THE MOON ROCKET continues on its way up after separating from its first stage at 35 miles up. Parachutes return the expended motors to earth.

Wonders of the Universe

Way Stations in Space

BY DR. I. M. LEVITT

Director, Fel Planitarium, Philadelphia

A ROCKET so huge and powerful that it could land a crew on the moon and later return to earth is not likely to be built within the next few years. The first men on the moon will probably reach that natural satellite from a space station — possibly within five years.

Last week we discussed how a straight thru rocket would make the round trip to the moon, but little has been done on such a project thus far. Work has already begun, however, on a system capable of initiating and sustaining an orbiting space station from which a moon flight could be made.

If sufficient funds are made available to Wernher von Braun and his space team at Huntsville, Ala., their Saturn system may be completed in time to put a man on the moon by the end of 1965.

Mightiest of All

The Saturn complex will be the most powerful rocket in the United States arsenal when it is completed. In addition, it will have more thrust than anything the Russians have yet unveiled. Plans are to cluster eight existing reliable rocket engines, each with a thrust of 165,000 pounds, as the first stage. An Atlas or Titan intercontinental ballistic missile would serve as the second stage, and an as yet undeveloped rocket engine using liquid oxygen and hydrogen as high energy fuel would be the third stage.

It is anticipated that the third stage motor will be ready for use by the time the other components become operational as a unit.

Total thrust would be about 1½ million pounds, weight about one million pounds. An orbiting payload of 17 tons would be reasonable for such a system, with seven tons in fuel and hardware for fabrication in space of a manned lunar rocket.

The Saturn system would also be capable of impacting 3,000 pounds on the moon in a straightaway thrust.

5 Miles a Second

Seven or eight rockets should be enough to take into orbit the 60 or 70 tons that would be necessary to fabricate the moon ship.

The lunar rocket thus constructed would already have an orbital speed of almost five miles a second and would need only to add slightly more than two miles a seond to reach escape speed [velocity required to overcome the earth's gravity]. This would require far less power than would be required for the same ship if it had to leave from the ground.

It will take such a space vessel about two days to reach the moon's vicinity. Once there, retro-rockets will brake the vessel into an orbit around the moon, and a small rocket ferry, carrying probably a single crewman, will make the actual descent. The mother ship will stay in orbit without making any effort to land.

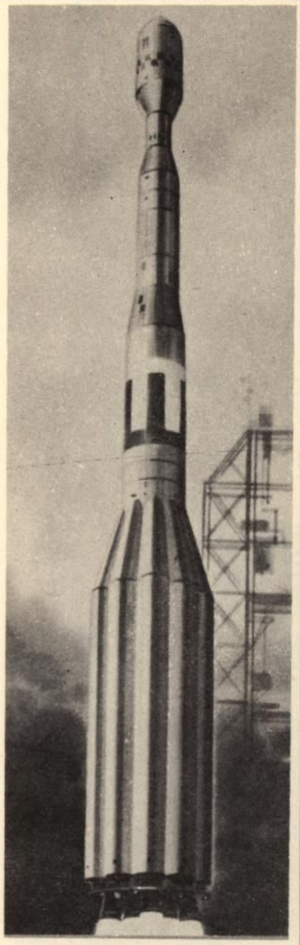
Rendezvous in Space

The ferry rocket is visualized with a tough plastic skin; the lighter the better so as little fuel as possible will be needed. Braking rockets will be used to effect a "soft" landing.

Once on the surface, the astronaut will explore a portion of the surface in a space suit. He can collect samples of the lunar surface, establish radio contact with the mother ship and perform whatever experiments are designated by the expedition's scientists.

Upon completion of his mission, the first man on the moon will return to an orbit rendezvous with the mother ship. Because of the moon's light gravity, his ferry will only need to reach a speed of one mile a second to accomplish this.

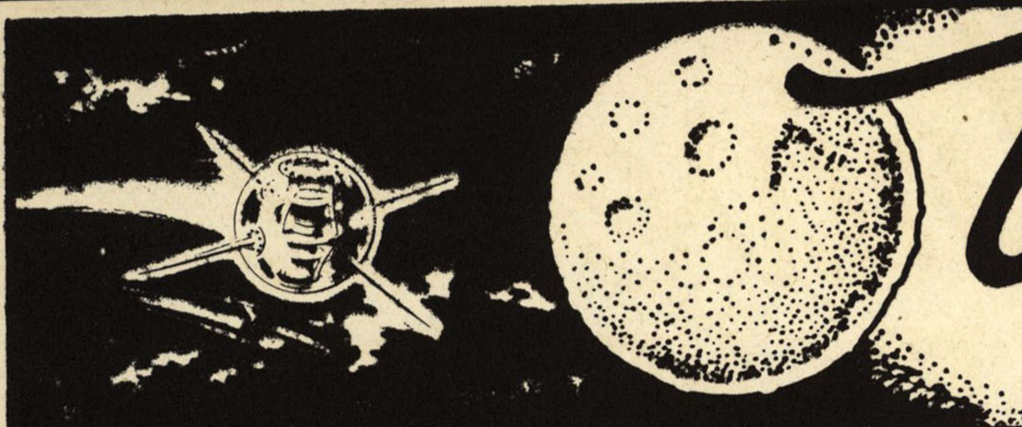
Once the astronaut has reached the mother ship, the ferry will be emptied of its lunar samples and either replaced inside the larger ship or left in orbit to be used possibly by other expeditions.



THE PROJECTED Saturn rocket system will make a landing on the moon possible. Sketch shows Saturn leaving the ground.

The moon rocket would then return to the earth's orbit or possibly to the earth itself tho after all the time, trouble, and expense to get its components off the earth to begin with it is unlikely that it would ever return to the ground.

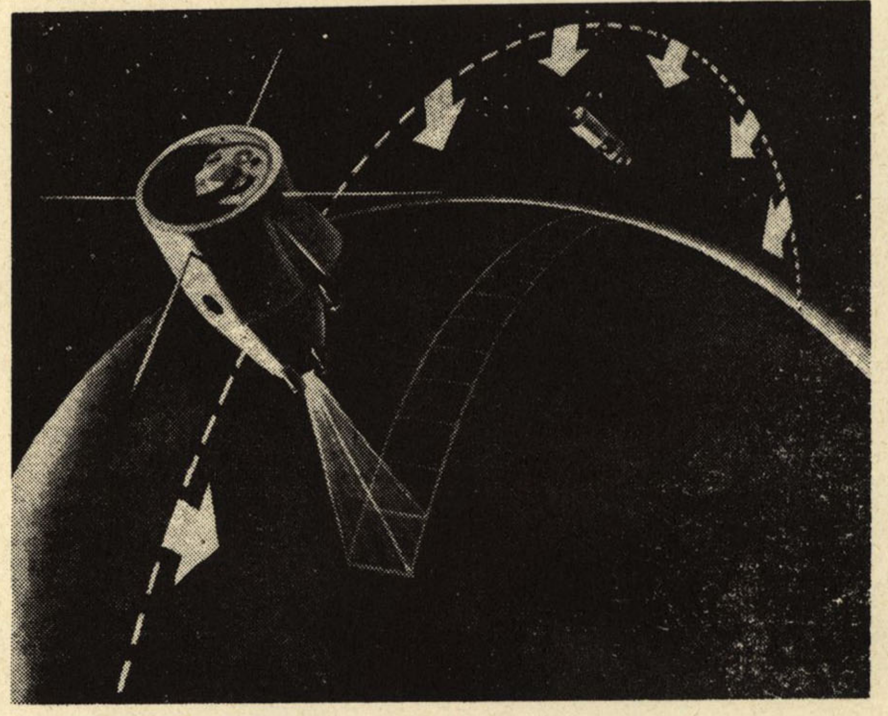
By then we may have special ferry rockets operating between the space station and earth, and the moon rocket crewmen with their lunar samples can return to the surface via "commuters" specials.



Wonders of the Universe

by DR. I. M. LEVITT

Nimbus Satellites to Predict Weather on World-Wide Scale



Two new Tiros satellites, due for launching soon, will contain a scanning system providing more detailed weather information.

WITHIN THE next year or two the launching of the first of a series of Nimbus Weather Satellites may give the United States the first secure hold on continuous meteorological information on a National Aeronautics and Space world-wide scale.

With this new family of meteorological satellites scientists of the Administration hope to receive definitive information which may lead to a significant increase in our knowledge of the atmosphere and which may permit civilian and military meteorologists to begin weather forecasts of unprecedented accuracy.

The Nimbus weather satellite is the natural evolution of a series of satellites which served as guinea pigs to see if desired meteorological data could be acquired.

The first of these test satellites was Vanguard II which contained photocells to detect the cloud cover of the earth. The second of the potential meteorological satellites was Explorer VII which used infrared detectors to derive the heat budget, that is, the heat inflow and outflow from the earth. The third was Tiros I launched April 1. This satellite before ceasing operations, transmitted over 22,000 pictures of the earth from space. The next logical step is the sophisticated Nimbus satellite.

However, before the first Nimbus goes into space, two more Tiros satellites are to be launched; one in late 1960—during the Fall and the other in the Spring of 1961. In addition to television systems, these satellites will also carry two sets of infrared detectors, one similar to that on Explorer VII and the other a scanning system providing more detailed information.

* * *

DR. MORRIS TEPPER, chief of the NASA Meteorological Satellite Program, disclosed that a tremendous complex of instruments will be developed to go into the Nimbus family of satellites planned for the next five years.

Contained in the Nimbus satellites will be a 800-line resolution television array: an electrostatic tape camera for cloud observations over the entire earth during daylight. An advanced television system is being planned for the later Nimbus satellites to record cloud cover by moonlight and, perhaps, even by starlight. Thus storm location, cloud type and motion will be derived both by day and night.

Scanning infrared detectors with a 30 by 30-mile spatial resolution will give the average temperature of the earth's surface, of the lower atmosphere and the tops of the cloud layers. The non-scanning infrared detectors will measure reflected solar radiation, radiation from the earth and from the atmosphere.

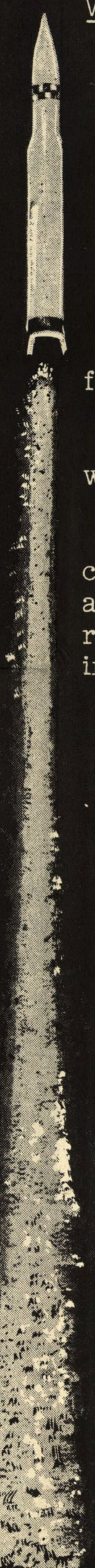
A spectrometer will be incorporated later to determine the composition of the atmosphere, the water vapor, ozone and carbon dioxide content and finally stratospheric temperatures.

* * *

AS RADAR is the only device which can penetrate clouds to detect rain and snow a radar system is being planned to record rain and snow areas on a global scale. It is further hoped that the heights and intensities of these disturbances can be determined.

General scientific experiments for studying earth-sun relationships are also being planned.

Dr. Tepper revealed physical details of the Nimbus satellite. It will be launched from a Thor Agena-B vehicle from the Pacific Missile Range and will be programmed to go into an almost circular polar orbit. The inclination of the orbit from a north-south line will be about 10 degrees and will compensate for the precession of the orbit around the earth. This will permit the satellite to press overhead at the same local time at any point on earth. The entire earth will be scanned from this satellite.



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AND IT'S STILL LEADING THE FIELD!!

WONDERS OF THE UNIVERSE heralded the rise of space science in America from an object of ridicule to a focus of unrestrained enthusiasm and eager attention.

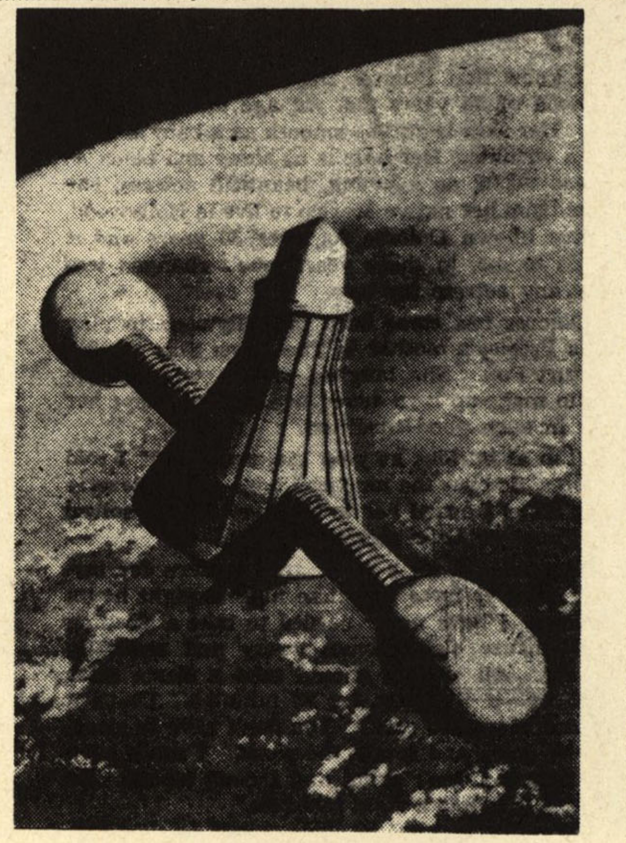
It was begun seven years before Sputnik by Dr. I. M. Levitt, director of the world-famous Fels Planetarium in Philadelphia.

Pioneering in space research and technology, WONDERS OF THE UNIVERSE correlates and condenses the complex, shifting facets of the modern space world and aims them straight at the layman. WONDERS OF THE UNIVERSE gives the reader a unique feeling of participating in the continuing progress of the most important scientific breakthroughs before they make news headlines.

YEARS AHEAD OF THE REST!!

FOR WEEK END RELEASE

Project Apollo Designed to Place 3-Man Space Station in Orbit



Project Apollo's space station will have three modules, with center one housing crew while in orbit.

A NEW name will soon flash across the astronautical horizon to bring with it hope for our space aspirations of the future.

In guarded language, our National Aeronautics and Space Administration is releasing information concerning Project Apollo, a major man-in-space advance that might become operational by 1966. And with this may come the breakthrough in manned flight being sought by our Congressional leaders. This project is being geared to overlap Project Mercury which is scheduled to run through 1962.

The objective of the new project is to support at least three men in space for periods ranging from two weeks to two months as a space station circling the earth or for shorter periods on a circumlunar mission.

The "building block" technique will be employed in this project with three complementary components making up the space station. The most critical component will be the command central module. The other two would serve as a propulsion module and a mission module.

* * *

GEORGE M. LOW, chief of NASA's Manned Space Flight Program, indicates that the command module "would house the crew during launch and re-entry of flight; it would also serve as the flight control center for the remainder of the mission." He also anticipates that this module would, "be identical for both circumlunar and earth-orbital missions." This central module could also be employed as an earth orbiting laboratory to execute many needed studies of the space environment.

The propulsion module could be used for circumlunar missions on which essential midcourse corrections could be supplied or in earth-orbital missions it would provide maneuverability to permit orbit modification or rendezvousing with other space craft. At launch it will be used to provide a safe landing for the astronauts in the event of an aborted mission.

The mission module would simply comprise an instrument assembly containing instruments developed for specific research tasks.

The research and development phases of this project with the inauguration of prototype flights will begin in 1962 and end in 1965. The full scale spacecraft will be flown in 1966.

* * *

FOR THE first time, comfort for the astronauts while in space is being planned in the early discussion stages. In the Mercury Project it is contemplated that the full pressure suit will be worn during the short orbiting times of the capsule. However, in the new project, at least for certain periods of flight, a "shirt sleeve" environment is planned to permit maximum comfort for the three-man crew.

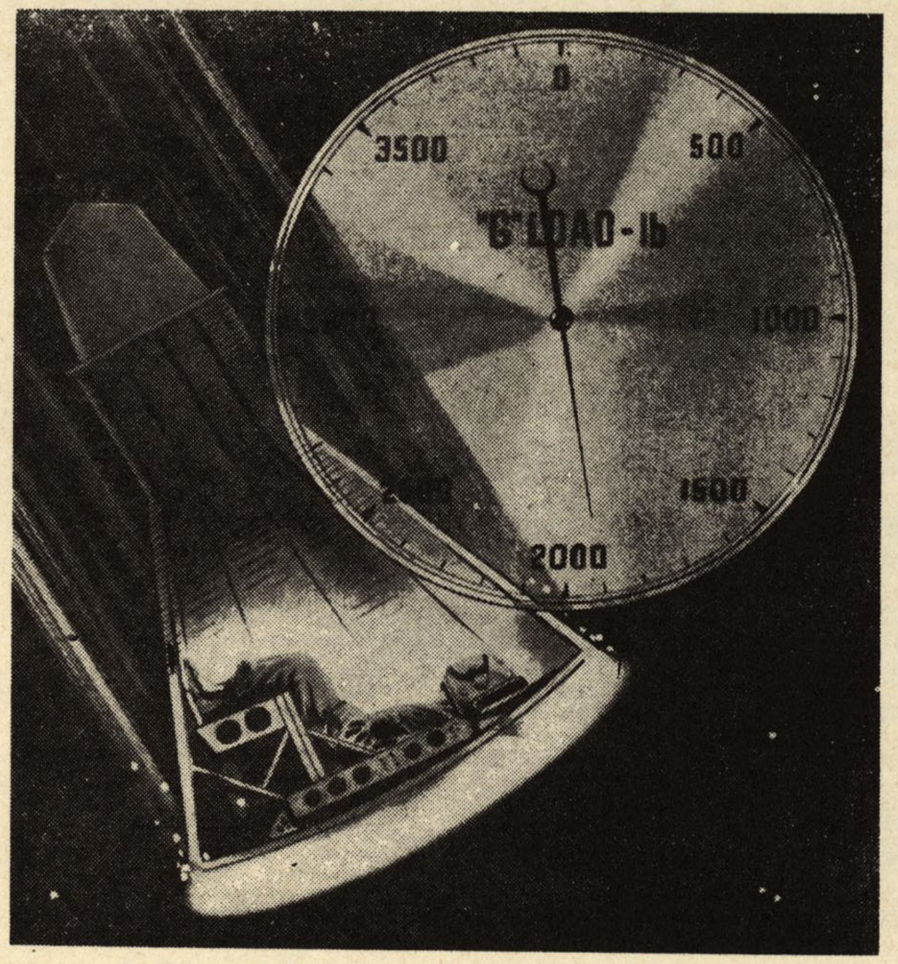
At this time the greatest handicap facing the project is the lack of suitable launching vehicles. Early tests plan the use of the Atlas Agena-B with the capability of putting 1,100 pounds into a 300-mile orbit. These tests will continue until the Saturn vehicle is available. The full scale Apollo assembly must use this largest of our launching vehicles to be placed in orbit.

* * *

THE PROBLEM of re-entry will also tax the abilities of scientists engaged on the new project. If the mission is a circumlunar one, then the vehicle will re-enter the earth atmosphere with a speed of about 36,000 feet a second. Safely bringing to the surface a vehicle moving at this speed is fantastically difficult; this despite the fact that both Russia and this country have re-entered an orbitting vehicle starting out with a speed of about 25,000 feet a second. Research currently under way in many laboratories may point the way to the solution of this all-important problem. But a solution must be found before the lunar mission can be undertaken.

Project Apollo is a bold concept and the success of this venture will go far in preparing the scientist for his ultimate goal—the moon.

Dr. I. M. Levitt is director of the famous Fels Planetarium of the Franklin Institute in Philadelphia. Dr. Levitt, a student of space travel for more than 20 years, is considered a leading authority on space age.



A 170-pound astronaut in the capsule during re-entry will increase in weight to about 2,000 pounds!

SEVERAL OBJECTS recovered from an orbital flight around the earth are now being studied. The Russians on Aug. 19 retrieved their Sputnik V with its cargo of dogs and insects. On Aug. 11, the U. S. Air Force recovered the data capsule from Discoverer XIII, the first object ever to be returned from orbit. Since that time, others have been returned and in the immediate future these Discoverer payloads will be coming back at the rate of about two a month.

In the case of the Russian recovery we know very little as to how they accomplished this feat. Despite the high degree of skepticism voiced by many people, this writer believes the Russian claims.

* * *

NOW THE Air Force has released enough information to show how this country managed to retrieve its space capsule.

For capsule recovery to be completely effective, the delicate monitoring instruments in the capsule could not be damaged in the recovery. Recovery of the package indicates that the re-entry temperatures reached by the ablative or heat shield of the capsule rose to 4,000 degrees F.

Above 70 miles, as in the case of meteors, the atmosphere is too thin to burn out the protective shield. However, at about 70 miles, instrument telemetry indicated that resistance to the passage of the capsule through the atmosphere zoomed the surface temperature to this high level.

* * *

TO PROTECT the interior of the capsule from the deteriorating effects of this temperature a plating of gold was placed on the outside of the instrument capsule to reflect the heat of the nose cone. This protected the instrumentation from excessive heat during the two minutes it takes the capsule to reach the 25-mile altitude where temperatures cease to be a problem.

When the capsule dug into the atmosphere the braking action of the atmosphere imposed a "g" load of 10 to 15 times the force of gravity. Thus had a 170-pound astronaut been in the capsule during this portion of the re-entry, he would have increased in weight to about 2,000 pounds.

The capsule was carefully programed to bring it back safely. During the 17th pass a timing device triggered gas jets to bring the altitude of the 300-pound capsule to the desired position, then explosive bolts separated the capsule from the second stage of the Thor-Agena vehicle.

* * *

IMMEDIATELY UPON separation the retro-rockets fired to drop the speed of the capsule below orbital velocity. The path of the capsule at this time was not too steep with respect to the horizon. In fact, the depression of the path with the horizonal was only 5 degrees.

Upon re-entering the atmosphere the angle became progressively steeper and the vehicle became hotter and moved slower. An accelerometer sensing the forces acting on the capsule operated a switch to open the parachute.

Following the opening of the parachute with its slow rate of descent, the air flotilla scouted for the capsule. While they missed an air catch, it was spotted and recovered from the ocean with its precious payload.